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The Metaphysics of Evolution: From Aquinas's Interpretation of Augustine's Concept of *Rationes Seminales* to the Contemporary Thomistic Account of Species Transformism[1]

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Introduction

One of the most important aspects of Augustine's *De Genesi ad litteram libri duodecim* is his concept of *rationes seminales*, which enabled him to assert that although God created everything instantaneously, in the initial state of the universe all species were present in the potency of the primordial matter, to be actualized at the consecutive stages of the history of its development.[2] Interpreted by St. George Jackson Mivart (1827–1900), John Zahm, C.S.C (1851–1921), and Henri de Dorlodot

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1 This article develops our preliminary delineation of the Thomistic metaphysics of evolutionary transitions presented in Mariusz Tabaczek, "What Do God and Creatures Really Do in an Evolutionary Change? Divine Concurrence and Transformism from the Thomistic Perspective," *American Catholic Philosophical Quarterly* 93, no. 3 (2019), 445–82, at 455–56 (section IV). Its core ideas were presented at the conference "Thomas Aquinas on Creation and Nature," organized by the Thomistic Institute at the Pontifical University of Saint Thomas Aquinas in Rome in October of 2019.

2 See Augustine, *De Genesi ad litteram libri duodecim* 5.5. All English translation of *De Gen. ad litt.* is taken from *The Literal Meaning of Genesis*, trans. John Hammond Taylor (New York: Newman Press, 1982).

(1855–1929) as an early anticipation of the theory of evolution, the idea of *rationes seminales* did not find much appreciation on the side of the father of the nineteenth-century revolution in biology—Charles Darwin.

The fact is that Augustine's theory did not assume a gradual transformation of one species into another. Such transition would not be acceptable within the context of the neo-Platonic definition of forms as fixed ideas in the mind of God, participated by created beings. Moreover, it seems that speaking of the actualization of *rationes seminales*, Augustine assumed two possibilities: they either (1) have a natural potential to gradually develop (unfold), under proper conditions, to the fullness of maturity, or (2) provide a proper ground (occasion) for God's instantaneous and direct (ordinary or special) intervention effecting an instantaneous appearance of the first representative of a given species in its adult form.[3] Needless to say,

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[3] See *De Gen. ad litt.* 6.14. Divine action in the world can be understood first as (1) direct (immediate) or (2) indirect (mediated). The former mode consists in God's affecting causal factors and natural occurrences at the level of their operation, which presupposes univocal predication of divine action and the causality of creatures (however, one may argue that the Thomistic idea of God's direct action of bestowing *esse* on each contingent entity is conceived in nonunivocal terms). The latter mode is defined as sustaining and bringing changes in nature by God as primary and principal (transcendent) cause, working (immanently) through secondary and instrumental causation of the creatures. As a side note, occasionalism may be treated as an extreme version of (1). Secondly, divine action in the world may be conceived as (3) instantaneous or (4) extended in time. On another (third) approach to its objective character and nature, divine action can be defined as (5) ordinary (general) or (6) special (particular, or miraculous). The former refers to God's regular action in the world, while the latter describes his particular actions in order to achieve some specific purposes in its history independently of the course of nature. God may achieve those purposes through: (a) producing effects that are beyond the power of nature (directly yet not univocally), (b) restraining secondary causes from producing their normal effects or producing those same effects directly (but not univocally) by his causal power alone, or (c) the mediation of secondary causes acting as instruments in working miracles. On yet another, fourth level of the debate concerning divine action, another distinction is made based on whether the world on which God acts is (7) deterministic or (8) indeterministic. The possibility of (7) assumes theo-physical compatibilism (which is opposite to theo-physical incompatibilism, stating that God could not act in the world that is deterministic). Finally, in reference to human beings, we may conceive God's action on them as (9) entities having true freedom of the will or (10) merely an elusive impression of it. The possibility of (9) assumes anthropo-theological compatibilism (which is opposite to anthropo-theological incompatibilism, stating that God could not act on a truly free human being). The five distinctions mentioned here result in a plurality of positions concerning divine action in the world. Some of the possible combinations are: 1-3-5-7; 1-3-5-

the latter option is unacceptable and becomes a stumbling block for the proponents of the modern evolutionary synthesis.

Thomas Aquinas refers to Augustine's *rationes seminales* on several occasions in his commentary on the work of six days in *Summa theologiae*, and in his other works, seemingly accepting the idea of all species (except for human species) being virtually present in the outcome of the initial act of creation, as well as accepting both possibilities of their actualization—through gradual development and through instantaneous and direct divine intervention. Assuming his theology in this matter follows faithfully the original thought of Augustine, it might be considered as being unable to fit within the context of the contemporary version of the evolutionary theory.

However, we must not forget that Aquinas's reference to Augustine's concept of *rationes seminales* was accompanied by his general acceptance of Aristotle's moderate realism about universals, including species, grounded in his hylomorphic metaphysics of substance. This fact provides an opportunity for redefining Augustine's concept of *rationes seminales* in terms of the hylomorphic theory of matter, which—in turn—enables it to accommodate the idea of the gradual transformation of species.

The main goal of this article is to develop such reinterpretation. In order to reach this goal, we will begin, in the first section, with the general presentation of Augustine's notion of creation in his *De Genesi ad litteram libri duodecim* and the short reflection upon the motives that inspired his introducing the concept of *rationes seminales*. The exact understanding

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8; 2-4-5-7-9 (in the Cartesian-type of a universe in which human freedom occurs in otherwise completely deterministic world); 2-4-5-7-10; 1-3-6a-8-9; etc.

Concerning Augustine's notion of God's intervention in bringing about the occurrence of the first exemplar of a given species in the mature stage of its development, it should be certainly classified as 1-3. With regard to the third distinction mentioned here, it seems to us that it might be considered as an instantiation of either 5, or 6a or 6b. God might have designed the world such that an instantiation of a new animal (or a new plant?) species requires his direct (immediate) and instantaneous intervention, which, nonetheless, belongs to its natural way of operation. Equally reasonable is an alternative scenario in which such an intervention is special and goes beyond God's regular causal activity in the world. Naturally, neither 1-3-5 nor 1-3-6a/6b is acceptable for Darwinian evolutionists because of 1-3. Concerning the fourth distinction, Augustine's notion of *rationes seminales*—regardless of whether their unfolding is spontaneous or requires direct and instantaneous God's intervention—will most likely opt for (7). The last distinction is irrelevant in this context, but we may assume that Augustine's weak theological determinism places him somewhere in between (9) and (10), most likely closer to (9), although this might be considered debatable.

of this concept in Augustine's theology is the subject of our investigation in our second section, which is then followed by a third section critically evaluating some early tendencies of regarding it as evolutionary. The fourth and fifth sections introduce the main objectives of Aquinas's reflection and interpretation of the account of the work of six days found in Genesis, as well as his use of Augustine's notion of *rationes seminales*. Next, in our sixth section, we develop and provide a constructive proposal of the Thomistic metaphysics of evolutionary transformism, which is then followed by our constructive proposal of the redefinition of the concept of *rationes seminales* in the seventh section. The article closes with the evaluation of the faithfulness of the proposed model to the core principles of the Aristotelian-Thomistic system of metaphysics and philosophical theology, as well as its relevance in the context of contemporary science.

Augustine's Notion of Creation

The point of departure for our analysis is the thought of Augustine commenting on the creation accounts in Genesis 1 and 2 in his *De Genesi ad litteram libri duodecim*.[4] Concerning the very act of creation Augustine clearly states that "God made everything together without any moments of time intervening."[5] Hence, he does not think we should understand literally the six days of the Genesis account: "We should not think of those days as solar days."[6] For how could there be solar days before the sun itself

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4 Ernan McMullin notes: "Twice Augustine attempted a commentary along allegorical lines on the disputed text of Genesis, but he was unsatisfied with the results. Finally in 415 A.D., after fourteen years of labor, he completed the *De Genesi ad litteram*, a detailed study of all the alleged points of conflict according to the 'proper historical meaning,' with frequent prescriptions as to how such conflict ought to be handled" ("Introduction: *Evolution and Creation*," in *Evolution and Creation*, ed. Ernan McMullin [Notre Dame, IN: University of Notre Dame Press, 1986], 1–56, at 1). Among these prescriptions, adds McMullin, one was to bring an attention of future generations, most notably of Galileo. He found inspirational and relevant Augustine's advice that, when conflict arises between a literal reading of the Bible and a truth about nature which has been demonstrated by reliable argument, the Christian should strive to reinterpret the biblical text in a metaphorical way (see *De Gen. ad litt.* 1.21). Our account of Augustine's concept of *rationes seminales* follows the one offered by McMullin.

5 *De Gen. ad litt.* 5.11.

6 *De Gen. ad litt.* 5.5. Following J. H. Taylor's introduction to the English translation of *De Gen. ad litt.*, Mc Mullin notes: "It ought be noted that Augustine's usage of the term 'literal' was much broader than ours. The 'literal meaning' alluded to in the title of his book, the meaning he searches for so painstakingly, was the meaning intended by the original author. 'Literal' for him was opposed to 'allegorical,' not to 'metaphorical.' Thus he could claim that 'day' in the Genesis account clearly had

came to be (in the Genesis account it was created on the fourth day)? At the same time, unlike the contemporary advocates of the old earth creationism, he does not extend the ordinary twenty-four-hour days of the creation account in Genesis 1 into much longer periods of time (thousands, millions, or billions of years).[7] Quite to the contrary, he thinks that God's creative act was instantaneous and that the six days in the biblical description might be interpreted allegorically as referring to the six stages of the angelic knowledge about creation.[8]

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to be taken metaphorically, that this was the author's plain intention. Hence the 'literal' meaning here (in his sense) was the metaphorical one" (McMullin, "Introduction," 50n29).

7 The camp of old-earth creationists includes: (1) gap creationists (ruin-restoration creationists), who think that, although the six-*yom* creation period in Genesis did involve six twenty-four-hours-long days, literally interpreted, there was an extended temporal gap between the two distinct stages of creation (as described respectively in Gen 1:1–2 and 1:3–31); (2) progressive creationists, who, accepting microevolution, think that God created so-called "natural species" (species defined at the level of family or order in the modern classification) through direct divine intervention, yet gradually, over a period of hundreds of millions of years; (3) day-age creationists, who hold that the six days referred to in the Genesis account of creation were not ordinary twenty-four-hour days, but rather were much longer periods (thousands or millions of years); and (4) cosmic time creationists, who, in reference to contemporary physics, consider the period of six days in the Genesis account under the conditions of quark confinement, when the universe was approximately a trillion times smaller and hotter than it is today, and suggest it is equal to fifteen billion years of earth time today (due to space expansion after quark confinement). Proponents of theistic evolution are oftentimes classified as day-age creationists (3), which is rather inadequate in the case of Augustine and those who follow him in his assertion that creation of the universe was instantaneous. For more information on (1), see Tom McIver, "Formless and Void: Gap Theory Creationism," *Creation/Evolution Journal* 8, no. 3 (1988): 1–24; for more on (2), see Alan Hayward, *Creation and Evolution: Rethinking the Evidence from Science and the Bible* (Ada, Ml: Bethany House, 1985), and Hugh Ross, *A Matter of Days: Resolving a Creation Controversy* (Colorado Springs, CO: NavPress, 2004); for more on (3), see Ronald L. Numbers, *The Creationists: From Scientific Creationism to Intelligent Design, Expanded Edition* (Cambridge, MA: Harvard University Press, 2006), chs. 2–4; for more on (4), see Gerald Schroeder, *Genesis and the Big Bang Theory: The Discovery Of Harmony between Modern Science And the Bible* (New York: Bantam, 1990).

8 As notes Aquinas: "For Augustine understands by the word 'day,' the knowledge in the mind of the angels, and hence, according to him, the first day denotes their knowledge of the first of the Divine works, the second day their knowledge of the second work, and similarly with the rest. Thus, then, each work is said to have been wrought in some one of these days, inasmuch as God wrought nothing in the universe without impressing the knowledge thereof on the angelic mind; which

Naturally, Augustine did not think that all things, including sun, earth, seas, plants, animals, and so on, came to be fully formed in that first moment. Comparing and contrasting the two creation accounts opening the book of Genesis he suggests that what were present in the first instant of the existence of the universe were only the "seed-principles" (*rationes seminales*; *logoi spermatikoi* [λόγοι σπερματικοὶ]) of all natural kinds, and that over the history of the universe God "unfolds the generations which He laid up in creation when He first founded it."[9] In other words, "[God] created all [creatures] together . . . whose visible forms He produces through the ages, working even until now."[10]

What inspired Augustine's thesis were not only the metaphysical principles of stoicism and neo-Platonism but also some biblical passages. First, in the Vulgate and, presumably, in the *Vetus Latina* version of the Bible available to Augustine, in the short passage from Sirach 18:1a we read "Qui vivit in aeternum creavit omnia simul," which translates as "He that liveth for ever created all things together."[11] Secondly, in the same version

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can know many things at the same time, especially in the Word, in Whom all angelic knowledge is perfected and terminated. So the distinction of days denotes the natural order of the things known, and not a succession in the knowledge acquired, or in the things produced. Moreover, angelic knowledge is appropriately called 'day,' since light, the cause of day, is to be found in spiritual things, as Augustine observes [*De Gen. ad litt.* 4.28]. In the opinion of the others, however, the days signify a succession both in time, and in the things produced" (*Summa theologiae* [*ST*] I, q. 74, a. 2, corp.; all English translation of *ST* comes from that done by the Fathers of the English Dominican Province).

McMullin values Augustine's cautiousness and openness for further clarifications of the proper interpretation of the "day" metaphor: "Whoever, then, does not accept the meaning that my limited powers have been able to discover . . . let him search and find a solution with God's help" (*De Gen. ad litt.* 4.28).

9 *De Gen. ad litt.* 5.20. Augustine calls *rationes seminales* also *causales rationes*, *rationes primordiales*, *primordia causarum*, or *quasi semina futurorum* (see 253n67 in Taylor's translsation of *De Gen. ad litt.*).

10 *De Gen. ad litt.* 5.23. Later on, in book 7, he adds: "The things [that God] had potentially created . . . [came] forth in the course of time on different days according to their different kinds . . . [and] the rest of the earth [was] filled with its various kinds of creatures, [which] produc[ed] their appropriate forms in due time" (*De Gen. ad litt.* 7.22).

11 This is the reading of the Douay-Rheims and represents Augustine's understanding of simultaneity in the statement. In The New American Bible, Revised Edition (NABRE), the same passage reads: "He who lives forever created the whole universe." The Greek version in the Septuagint is closer to the older translations, with the Greek *panta* more in its usual sense of "all" or "whole," rather than in the sense of the Latin *simul*: "Ho Zōn eis tōn aiōna ektisev ta panta koinē [῾O ζῶν εἰς τὸν αἰῶνα ἔκτισεν τὰ πάντα κοινῇ]."

of the Bible, the passage from Genesis 2:4–5a reads as follows: "Istae sunt generationes caeli et terrae, quando creata sunt, in die quo fecit Dominus Deus caelum et terram, et omne virgultum agri antequam oriretur in terra, omnemque herbam regionis priusquam germinaret." This translates into English as: "These are the generations of the heaven and the earth, when they were created, in the day that the Lord God made the heaven and the earth: and every plant of the field before it sprung up in the earth, and every herb of the ground before it grew."[12] It is commonly accepted that both passages mentioned here inspired Augustine's use of the concept of *rationes seminales* in the context of his commentary on Genesis.

Going back to his work, even if he thought that the first account of creation in Genesis was summarized by the second one, Augustine emphasized the difference between the two descriptions and claimed that the latter referred to the later stage of divine action in the already created universe, bringing about from the primitive matter new kinds of entities (new species), that preexisted in it as *rationes seminales*. Hence, we may say that for Augustine all species had been created at once, while their unfolding was (is?) extended in time.[13]

This reading of Genesis, notes Ernan McMullin, was not entirely a novel one. The Alexandrine fathers already thought that the universe began from a single divine act and that six days in Genesis 1 should be taken allegorically. Gregory of Nyssa went even further saying that what came to be in the act of creation were the potencies of all that would come later:

> The sources, causes, and potencies of all things were collectively sent forth in an instant, and in this first impulse of the Divine Will, the essences of all things assembled together: heaven, aether, star, fire, air, sea, earth, animal, plant—all beheld by the eye of God. . . . There followed a certain necessary series according to a certain order . . .

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12 Douay-Rheims. In NABRE the same passage reads: "This is the story of the heavens and the earth at their creation. When the LORD God made the earth and the heavens—there was no field shrub on earth and no grass of the field had sprouted." A purely formal-equivalence translation from Hebrew would follow the old translation: "These [are] the generations the heavens and the earth when they were created in the day that Yahweh God made the earth and the heavens, before any plant of the field was in the earth and before any herb of the field had grown" (see biblehub.com/interlinear/genesis/2.htm).

13 Although he may not state it clearly, we can assume Augustine understood divine action in unfolding of the *rationes seminales* as the activity of God working through contingent (secondary) causes.

> as nature the maker [*technikē physis* (τεχνικὴ φύσις)] required . . . appearing not by chance . . . but because the necessary arrangement of nature required succession in the things coming into being.[14]

The Meaning of Rationes Seminales

But what exactly are *rationes seminales*? They do not seem to be empirically verifiable seeds in the common understanding of the term. They are hidden from our sight. Augustine compares them to the principle whereby we grow old, which lies in each one of us already when we are young.[15] Even if such a principle cannot be seen by our eyes, "by another kind of knowledge we conclude that there is in nature some hidden force by which latent forms are brought into view."[16] In other words, says Augustine: "There is, indeed, in seeds some likeness to what I am describing, because of the future developments stored up in them. Indeed, it is the seed-principle which is the more basic of the two, since it comes before the familiar seeds we know."[17] Hence, each seminal reason (seed-like principle) is best described as potentiality—a very specific potentiality of a particular and fixed type of entity or natural kind (species). Augustine introduces an analogy of the tree that originates from the seed that itself originates from another tree, noting that they both originate from the earth:

> In the seed, then, there was invisibly present all that would develop in time into a tree. And in this same way we must picture the world, when God made all things together, as having had all things which were made in it and with it when day was made. This includes not only heaven with sun, moon and stars . . . but also the beings which water and earth produced in potency and in their causes before they came forth in the course of time.[18]

And here comes a major difficulty in interpretation. On the one hand,

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14 Gregory of Nyssa, *Apologia in hexaemeron* (PG, 44:72); quoted by Ernest C. Messenger in *Evolution and Theology: The Problem of Man's Origin* (New York: Macmillan, 1932), 24 (trans. slightly modified).

15 "The principle which makes this development possible is hidden to the eyes but not to the mind; but whether such a development must necessarily come about is completely unknown to us. We know that the principle which makes it possible is in the very nature of body; but there is no clear evidence in that body that there is a principle by which it must necessarily take place" (*De Gen. ad litt.* 6.16).

16 *De Gen. ad litt.* 6.16.

17 *De Gen. ad litt.* 6.6.

18 *De Gen. ad litt.* 5.21.

Augustine seems to claim that when the proper conditions are met, gradual and spontaneous unfolding of *rationes seminales* occurs naturally: "All things were created by God in the beginning in a kind of blending of the elements, but they cannot develop and appear until the circumstances are favorable."[19] On the other hand, however, he sometimes tends to interpret Genesis more literally as implying that each new kind originates in its adult form. This, naturally, makes it hard to imagine how an adult form may originate from a seed without going through a normal process of development and growth. Hence, it becomes apparent that such an origin might require a more direct and instantaneous divine intervention.

Consequently, when discussing the origin of the first human body—in reference to the neo-Platonist dualistic distinction between body and soul, and presupposing that human soul does not originate from *rationes seminales* but is directly created by God *ex nihilo*—Augustine seems to assert that the seed-principles have a double potentiality: (1) the potentiality that manifests in the slow growth (unfolding) in the favorable conditions of the environment; (2) the potentiality that provides a suitable ground for the instantaneous and direct (general or special) divine production of the first adult form of a new kind.[20]

If (1) is true with regard to the origin of natural kinds of living organisms, then no special divine intervention seems to be necessary. And yet, says Augustine:

> God has established in the temporal order fixed laws governing the production of kinds of beings and qualities of beings and bringing them forth from a hidden state into full view, but His will is supreme over all. By His power He has given numbers to His creation, but He has not bound His power by these numbers.[21]

The "numbers" here are the laws of nature.[22] Even if the seed-principles unfold according to these "numbers," this does not exclude the possibility of divine intervention that is able to bring about an outcome that would

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19 Augustine, *De Trinitate* 3.9, quoted in Eugène Portalié, *A Guide to the Thought of St. Augustine* (Chicago: Regnery, 1960), 138.

20 See *De Gen. ad litt.* 6.13–14. Although the question about the way of unfolding of *rationes seminales* is asked in reference to the origin of the first human body, Augustine refers it to all other seed-principles.

21 *De Gen. ad litt.* 6.13.

22 McMullin says this was Augustine's influential interpretation of Wis 11:20: "Thou hast ordered all things in measure and number and weight" (see *De Gen. ad litt.* 4.3–5; McMullin, "Introduction," 51n47).

not "naturally" occur. Hence, "whichever way God made Adam [and he might have made him through a direct divine intervention], He did what was in accordance with his almighty power and wisdom."[23]

If (2) is true with regard to the origin of natural kinds of living organisms, then no *rationes seminales* seem to be needed, since the Creator is able to transform anything into anything at his divine will. And yet, says Augustine,

> If we should suppose that God now makes a creature without having implanted its kind in His original creation, we should flatly contradict Sacred Scripture which says that on the sixth day God finished all his work.[24]

In other words, even if God directly intervenes to make man (and, arguably, other natural kinds of living organisms), he does not do this *ex nihilo*, as in the first creation, but takes the earth (the elements or matter on a lower level of its complexity) and draws on its potencies, even if what he does goes beyond its natural active and passive dispositions.

Augustine discusses both possible interpretations of the potentiality of *rationes seminales* and asks which option (1 or 2) is ultimately true. Unfortunately, he does not seem to provide us with a clear-cut and satisfying answer to this question. He thinks we should acknowledge that natural kinds came (come) into being in both ways: "We must conclude, then, that these reasons [*rationes seminales*] were created to exercise their causality in either one way or the other: by providing for the ordinary development of new creatures in appropriate periods of time, or by providing for the rare occurrence of a miraculous production of a creature, in accordance with what God wills as proper for the occasion."[25] However, while it becomes apparent that he thought Adam came to be without an observable process of growth and development (i.e., through direct divine intervention), he does not seem to clarify whether other species might have been produced/created in the same way or, if so, which one might have been.[26]

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23 *De Gen. ad litt.* 6.13. Augustine seems to assume that God indeed brought Adam into existence as an adult man.

24 *De Gen. ad litt.* 5.20.

25 *De Gen. ad litt.* 6.14

26 Augustine uses the term "making," which is equivalent with "producing" with reference to human body. At the same time, he believes human soul is created by God *ex nihilo*.

Augustine's Creation Theology as Evolutionary

Despite the difficulty in explaining the nature of the potentiality of *rationes seminales*, Augustine's interpretation of the creation account in Genesis became an attractive point of reference in the advent of the debate concerning Darwin's theory of evolution. It was in this context that an attempt was made to describe Augustine's theory as "evolutionary." Such was the opinion of a number of theologians and philosophers, especially at the early stage of the controversy over Darwin's *Origin of the Species*, when the attitude of the Church and of Christians to this new theory was, to say the least, reserved and skeptical. To have the authority of Augustine in support of the preliminary version of theistic evolution was regarded by them as a major argument in favor of the credibility of their theory.

To give some examples, in 1871, in his *On the Genesis of Species*, Mivart, a British biologist and convert to Catholicism, although critical about strictly naturalistic (agnostic or atheistic) interpretations of Darwin's ideas, claimed that theistic evolution was "thoroughly acceptable to the most orthodox theologians." In doing so he referred to the works of Augustine, Aquinas, and Francisco Suárez.[27] Similar to Mivart, John Zahm, C.S.C., in 1896, in his *Evolution and Dogma*, claimed that the "most venerable philosophical and theological authorities" of the Catholic Church (including Augustine and Aquinas) supported theistic evolution.[28] In 1921 Henry de Dorlodot, the director of the Catholic University of Louvain's geological institute, in his *Le Darwinisme aupoint de vue de l'orthodoxie catholique* (translated in

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[27] St. George Jackson Mivart, *On the Genesis of Species* (New York: D. Appleton, 1871), 317. See also 302–5. More information about Mivart and the criticism of his position may be found in Mariano Artigas, Thomas F. Glick, and Rafael A. Martínez, *Negotiating Darwin: The Vatican Confronts Evolution, 1877–1902* (Baltimore, MD: Johns Hopkins University Press, 2006), 236–69 (ch. 7: "Happiness in Hell: St. George J. Mivart); and Don O'Leary, *Roman Catholicism and Modern Science: A History* (New York: Continuum, 2006), 78–93, 103–8.

[28] John Augustine Zahm, *Evolution and Dogma* (Chicago: McBride, 1896), 312. Zahm's book was well received and became a bestseller in the United States. It also received some good reviews in Europe, but not in Rome. Some officials of the Roman Curia accused Zahm of presenting Augustine and Aquinas as evolutionists. His book was denounced to the Congregation of the Index on November 5 of 1897 with the recommendation of issuing a public condemnation of the book. The Congregation did not accept this suggestion but issued a decree of personal condemnation to Zahm, channeled through the Superior General of his congregation. After that Zahm quietly withdrew from his role as an apologist of the Church in matters of theology and science dialogue. See Artigas, Glick, and Martínez, *Negotiating Darwin*, 124–202 (ch. 4: "Americanism and Evolutionism: John A. Zahm"), and O'Leary, *Roman Catholicism*, 97–100.

1922 by E. C. Messenger as *Darwinism and Catholic Thought*), argued that Catholics were at liberty to accept Darwin's idea of the transformation of species. Similar to Mivart and Zahm, he was confident that he remained within the bounds of orthodoxy and invoked the works of Augustine in particular for support. He referred extensively to *De Genesi ad litteram*.[29]

But one has to be careful not to make too strong a claim. For Augustine certainly did not hold that one species can arise from the other. Within the context of his neo-Platonist theory of forms as eternal and unchangeable ideas in the mind of God, participated by created beings, such hypothesis would not be acceptable.[30] In his understanding of nature, species unfold at the proper time out of their own seed-principles, which were already present at the first moment of the existence of the universe. Hence, although he accepted gradualism (without contradicting the possibility of direct divine interventions in the actualization of *rationes seminales*), he should not be regarded as a precursor of the modern evolutionary theory.

Indeed, it was precisely Augustine's strong conviction that God made everything simultaneously at the moment of creation *ex nihilo* (without any moments of time intervening) that made his theory unacceptable for Darwin, who wanted to argue in favor of the historical origin of new species which were not present before. Moreover, the uncertainty regarding the possibility, if not a necessity, of a direct and instantaneous divine intervention in the actualization of *rationes seminales*, made Augustine's position even less tolerable for the proponents of Darwinian evolution.[31]

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29 See: Henry de Dorlodot, *Le Darwinisme au point de vue de l'orthodoxie catholique* (Brussels: Lovanium, 1921); de Dorlodot, *Darwinism and Catholic Thought* (New York: Benziger, 1922). Dorlodot's tribute to Darwin was warmly received in England but invoked some criticism in Belgium (see O'Leary, *Roman Catholicism*, 126–28). Messenger also discusses his ideas in his *Evolution and Theology*.

30 See *De Gen. ad litt.* 4.5.

31 Darwin explicitly criticized the concept of God independently creating each species: "To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes, like those determining the birth and death of the individual. When I view all beings not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Cambrian system was deposited, they seem to me to become ennobled" (Charles Robert Darwin, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*, 6th ed. [London: John Murray, 1872], 428). In the same, concluding chapter of his book, Darwin quotes from the letter received from his friend the Reverend Charles Kingsley, who had written that he had "gradually learnt to see that it is just as noble a conception of the Deity to believe that He created a few original

Augustine's world appears to be a kind of a pre-established harmony in which everything has been decided and "written" down in the potentiality of the first primitive matter. He did not understand the potentiality he spoke about as a general metaphysical principle underlying the very fabric of the universe. Rather, he saw it as a potentiality for unfolding and coming into existence of concrete and fixed types of entities (natural kinds). Hence, even if he says that "it is obvious that in accordance with those kinds of creatures which He first made, God makes many new things which He did not make then," he adds that "we cannot believe that He establishes a new kind, since He finished all His works on the sixth day."[32] Consequently, the question arises of whether the unfolding new natural kinds are truly new or just appear to us to be new, while in fact they are not.

Aquinas's Notion of Creation

Augustine's concept of *rationes seminales* and his interpretation of the opening chapters of the book of Genesis found acceptance and support among various thinkers, including Bonaventure, Albert the Great, Roger Bacon, and Nicolas Malebranche. Yet the most prominent and influential follower of his ideas was most likely Thomas Aquinas. As is well known, the Angelic Doctor contrasted Augustine's position with the opinion of Ambrose and other fathers of the Church, who read the Bible more literary and considered the act of creation not as instantaneous, but rather extended in time (six days or six longer periods of time). Aquinas is known for his balanced evaluation of both opinions. Early on, in his *Commentary on the Sentences of Peter Lombard*, we find him saying:

> Thus with respect to the beginning of the world something pertains to the substance of faith, namely that the world began to be by creation, and all the saints agree in this. But how and in what order this was done pertains to faith only incidentally insofar as it is treated in Scripture, the truth of which the saints save in the different explanations they offer.[33]

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forms capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the actions of His laws" (422).

32 *De Gen. ad litt.* 5.20.

33 *In* II *sent.*, d. 12, q. 1, a. 2, corp. (translation from the *Scriptum* is mine; from the Latin ed. P. Mandonnet [Paris: P. Lethielleux, 1929–1947]). Similar is Aquinas's opinion offered in his *Quaestiones disputatae de potentia Dei*: "This incorporeal agent by whom all things, both corporeal and incorporeal are created, is God, as

Later on, in *De potentia*, commenting on the positions of Augustine and Ambrose, Aquinas adds:

> The first explanation of these things, namely that held by Augustine is the more subtle, and is a better defense of Scripture against the ridicule of unbelievers: but the second, which is maintained by the other saints, is easier to grasp, and more in keeping with the surface meaning of the text. Seeing however that neither is in contradiction with the truth of faith, and that the context admits of either interpretation, in order that neither may be unduly favored we now proceed to deal with the arguments on either side.[34]

However, although he is supportive of both interpretations of Genesis, Aquinas seems to be following Augustine's opinion more than the one offered by Ambrose. First of all, he understands creation *ex nihilo* as the coming into being out of nothing (i.e., not from a preceding being of any kind) of the most primitive types of contingent entities: the elements. He thus sees it as an act that was instantaneous, rather than extended in time. We infer this based on Aquinas's differentiation between the work of creation (*opus creationis*) and those of distinction (*opus distinctionis*) and adornment (*opus ornatus*), in his analysis of the work of six days in the first part of the *Summa theologiae*.[35]

The outcome of the work of creation (*opus creationis*) was the coming into existence of the most primitive matter (*materia secunda*), which was, in fact, inseparable from the first three stages of distinction (*opus distinctionis*), the second of which was the distinction "of the elements according to their forms."[36] The outcome of the work of distinction (*opus distinctionis*) was the separation of land from the sea, accompanied by the preliminary

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we have proved above (*De potentia*, q. 3, aa. 5, 6, 8), from whom things derive not only their form but also their matter. And as to the question at issue it makes no difference whether they were all made by him immediately, or in a certain order as certain philosophers have maintained" (*De potentia*, q. 5, a. 1, corp.; all English of *De potentia* is from the translation by the Fathers of the English Dominican Province).

34 *De potentia*, q. 4, a. 2, corp.

35 See Aquinas's introduction to *ST* I, q. 65.

36 And even if only earth and water are named, adds Thomas, the author of Gen 1:2 had in mind air and fire as well. The reason he does not mention them is that "the corporeal nature of these would not be so evident as that of earth and water, to the ignorant people" to whom he spoke (see *ST* I, q. 66, a. 1, ad 3, reply to sc 2 of obj. 3).

stage of the work of adornment (*opus ornatus*), the production of plants.[37] The outcome of the work of adornment (*opus ornatus*) was the production of celestial bodies and animals, and the creation of man.[38] See Figure 1.

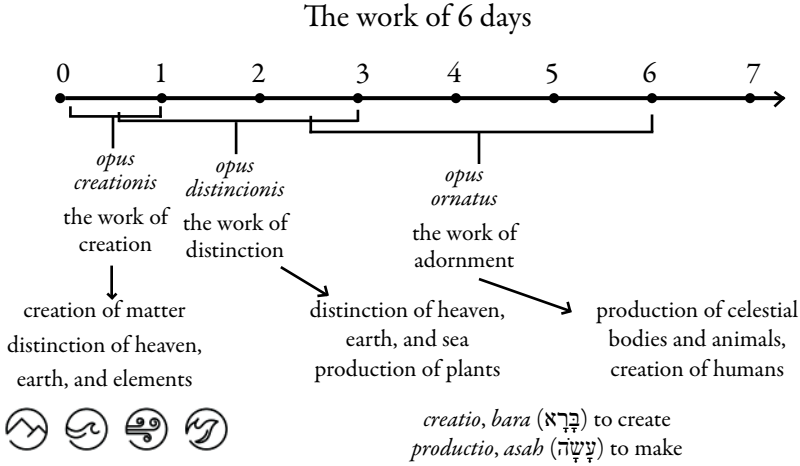

Figure 1. Graphic depiction of the sequence of the work of six days in the account of Genesis 1.

Aquinas's Use of Augustine's Notion of Rationes Seminales

If this is true, it becomes clear that for Aquinas the subsequent production (*productio*) of more complex contingent beings was, in a way, mediated through the most basic forms of material stuff—the origin of which was the outcome of the work/act of creation (*opus creationis*). In other words, more complex entities, in some respect, came "from" them. Aquinas realizes that even literal interpretation of Genesis suggests that (1) it was earth that brought forth plants, the green herbs and fruit trees; (2) it was water that brought forth an abundance of swimming creatures and birds (although Genesis does not say explicitly where they came from); (3) it was earth that brought forth all kinds of living creatures, such as cattle, creeping things, and wild animals of all kinds. Hence, following Augustine's concept

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37 We must remember that in antiquity many thought plants were not living organisms because they do not move and allocate themselves. Hence, the production of plants in the account of Genesis preceded the actual *opus ornatus*.

38 Aquinas's distinction between *creatio* and *productio* seems to correspond with the distinction between Hebrew "to create" (*bara* [בָּרָא]) and "to male" (*asah* [עָשָׂה]).

of *rationes seminales*,[39] Aquinas states that plants and trees might have been produced "in their origin or causes," that is, the earth "received . . . the power to produce them." They were subsequently brought into existence in "the work of propagation."[40] Similar with fishes and birds, which Augustine saw as produced by "the nature of waters on that [fifth] day potentially," [41] and animals, whose "production was potential" as well.[42]

This clear reference to Augustine's concept of *rationes seminales* faces the challenge of their double potentiality, that is, (1) their potentiality to naturally and spontaneously unfold in favorable circumstances, and (2) their

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39 Although Aquinas uses the term *rationes seminales* explicitly on numerous occasions in his commentary on the *Sentences.*, in other parts of *ST*, in *De veritate*, *De potentia*, and *De malo*, and in some biblical commentaries, he paradoxically does not use it in his analysis of the works of six days (*ST* I, qq. 65–74). At the same time, however, he does refer in these questions directly to the authority of Augustine and his concept of all types of creatures existing in *statu potentiae* in the earth (the primitive elements) and unfolding at the proper time, contrasting his view with the one held by "other holy writers."

40 *ST* I, q. 69, a. 2, corp.: "In these first days God created all things in their origin or causes, and from this work He subsequently rested. Yet afterwards, by governing His creatures, in the work of propagation, 'He worketh until now.' Now the production of plants from out the earth is a work of propagation, and therefore they were not produced in act on the third day, but in their causes only."

41 *ST* I, q. 71, a. 1, corp.

42 *ST* I, q. 72, a. 1, corp. See also *De potentia*, q. 4, a. 2, ad 28: "Before the plants were produced causally, nothing was produced, but they were produced together with the heaven and the earth. In like manner the fishes, birds and animals were produced in those six days causally and not actually". Aquinas alludes to the concept of *rationes seminales* on several other occasions: (1) "God is said to have stopped creating new creatures on the seventh day because nothing was made afterwards that did not come first in some likeness according to genus or species, at least in a seminal principle . . . Therefore, I say that the future renewal of the world indeed came first in the works of the six days in a remote likeness" (*In* IV *sent.*, d. 48, q. 2, a. 1, ad 3); (2) "For we see that all things which, in the process of time, being created by the work of Divine Providence, were produced by the operation of God, were created in the first fashioning of things according to seedlike forms [*seminales rationes*], as Augustine says [*De Gen. ad litt.* 7.3], such as trees, animals, and the rest" (*ST* I, q. 62, a. 3, corrp.); (3) "In the first production of things matter existed under the substantial form of the elements. . . . In the first instituting of the world animals and plants did not exist actually. . . . On the day on which God created the heaven and the earth, He created also every plant of the field, not, indeed, actually, but 'before it sprung up in the earth,' that is, potentially [*potentialiter*]. . . . God created all things together so far as regards their substance in some measure formless. But He did not create all things together, so far as regards that formation of things which lies in distinction and adornment" (*ST* I, q. 74, a. 2, corp. and ad 1–2).

potentiality understood as providing a suitable ground for the instantaneous and direct (general or special) divine intervention in the production of new forms of living creatures. Unlike Augustine, who, as we have seen, remained uncertain as to whether the production of each animate species involved(s) a direct divine intervention, Aquinas introduces an important distinction, which strives to further clarify Augustine's position.

Commenting on the second book of *Sentences* of Peter Lombard Aquinas claims that the origin of plants requires merely causal principles proper for the work of distinction (*opus distinctionis*), and adds that the role of fathering in this process belongs to the powers of celestial bodies, while the role of the mother is fulfilled by the primordial matter (i.e., elements).[43] Similar is his opinion presented in *De potentia*, where we find him saying:

> Now the production of plants from the earth into actual existence belongs to the work of propagation, since the powers of the heavenly body as father, and of the earth as mother suffice for their production. Hence the plants were not actually produced on the third day but only in their causes: and after the six days they were brought into actual existence in their respective species and natures by the work of government.[44]

However, the case of animals might look different. Concerning their origin Aquinas emphasizes that:

> Those things that are naturally generated from seed cannot be generated naturally in any other way. . . . In the natural generation of all animals that are generated from seed, the active principle lies in the formative power of the seed. . . . The material principle, however, in the generation of either kind of animals, is either some element, or something compounded of the elements. But at the first beginning of the world the active principle was the Word of God, which produced animals from material elements, either in act, as some holy writers say, or virtually [*virtute*], as Augustine teaches.[45]

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43 See *In* II *sent.*, d. 14, q. 1, a. 5, ad 6.

44 *De Potentia*, q. 4, a.2, ad 28. It should be remembered that the second part of the corpus and all responses to arguments in this article were probably written by Vincentius Castronovo and not by Aquinas himself, who probably left the article in question unfinished.

45 *ST* I, q. 71, a. 1, ad 1; see also *In* II *sent.* d. 14, q. 1, a. 5, ad 6.

This theological opinion of Aquinas leaves space for an interpretation assuming that no direct divine intervention is needed in the actualization of animal species. They might have been produced virtually (as *rationes seminales*), and similar to the plant species, they may spontaneously unfold in the proper conditions of the environment. However, we must not forget that, concerning the origin of Adam, Thomas clearly states that a direct divine intervention was necessary:

> The first formation of the human body could not be by the instrumentality of any created power, but was immediately from God. . . . Therefore as no pre-existing body has been formed whereby another body of the same species could be generated, the first human body was of necessity made immediately by God.[46]

This assertion concerns Adam's body. When it comes to his soul Aquinas emphasizes that "the rational soul can be made only by creation." At the same time, he adds this "is not true of other forms," which means they may be generated by contingent causes.[47] Indeed, on another occasion Aquinas claims that "the form of the thing generated depends naturally on the generator in so far as it is educed from the potentiality of matter."[48] This might suggest, once again, that the occurrence of new animate (including animal) species may proceed from the natural processes of actualization (unfolding) of *rationes seminales*. However, one may argue

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46 *ST* I, q. 91, a. 2, corp. We should also remember that because heavenly bodies were thought of as indestructible, they could not have come into existence from any preexisting destructible matter. Hence, in accordance with Augustine's view, they could not have unfolded from *rationes seminales*. It seems they must have been created through a direct divine intervention as well. However, McMullin notes that even if Aquinas asserts Augustine was "not at variance" with other writers in regard to the heavenly bodies ("For he says that they were made actually and not merely virtually, since the firmament has not the power of producing luminaries, as the earth has of producing plants" [*ST* I, q. 70, a. 1, corp.]), the reference to the text he cites from Augustine (*De Gen. ad litt.* 5.5) makes his reading dubious. For although Augustine does say there that "on the fourth day, the lights and stars were created," he makes this claim in a paragraph about "those beings which were formed from formlessness (unformed matter) and are clearly said to be created." He appears to be using the term "created" here in the sense of "drawing forth from a prior matter," the sense that Aquinas wants to exclude (See McMullin, "Introduction," 52n65).

47 *ST* I, q. 90, a. 2, corp.

48 *De Potentia*, q. 5, a. 1, corp. On Aquinas's defense of the unity of man, see *ST* I, q. 76, a. 4.

that what Aquinas has in mind here is the generation of new exemplars of an already existing species, and not the coming to be of the first exemplar of a new species. For, indeed, on yet another occasion Thomas seems to be saying that the origin of the first member of each new animal species requires, in fact, a direct divine intervention:

> [Some things come into being neither through motion nor through generation] because of the necessity that generation always generates what is similar in species. For this reason the first members of the species were immediately created by God, such as the first man, the first lion, and so forth.[49]

Consequently, we must acknowledge that, although he tried to, Aquinas did not succeed in clarifying Augustine's position on the exact nature of the potentiality of *rationes seminales*. Similar to Augustine, he remained unclear in specifying which types of natural kinds may originate through natural unfolding (actualization) of seed-principles and which require a direct divine intervention. Moreover, assuming his theology in this matter follows faithfully the original thought of Augustine, it might be considered as being unable to fit within the context of the modern and contemporary versions of the evolutionary theory.

However, we must not forget that Aquinas's reference to Augustine's concept of *rationes seminales* was accompanied by his general acceptance of Aristotle's moderate realism about universals, including species, grounded in his hylomorphic metaphysics of substance. Aristotle is known for criticizing Plato's concept of species conceived as immutable forms, separated from matter and existing in the realm of eternal ideas. For him species are real, immutable, and eternal in the sense that each one of them is defined by a substantial form of a particular kind, which causes each organism belonging to a given species to be what it is and to exhibit a set of fixed and permanent traits. At the same time, however, every species exists only as realized in concrete, temporal, individual, and contingent organisms. Thus, while the essential intrinsic traits of a species are immutable, their

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[49] *In* II *sent.*, d. 1, q. 1, a. 4, corp. However, this might not be true about at least some species of insects, of which Aquinas says here that they originated from putrefaction: "Man, for instance, can only be generated from man. It is, however, otherwise with those things which are not generated by an agent that is similar to them in species. For these, rather, the power of celestial bodies along with appropriate matter is sufficient, as, for example, those things which are generated by putrefaction."

existential exemplifications and realizations in nature are not. Aristotelian metaphysics allows us to argue that all representatives of a species share a "common nature" (defined by a substantial form of a particular kind), which finds its expression in the variety of inter-actions and inter-relations between unique individuals that differ in terms of many accidental features.

This understanding of species provides an opportunity for redefining Augustine's concept of *rationes seminales* in terms of the hylomorphic theory of matter, which, in turn, enables it to accommodate the idea of the gradual transformation of species.

Thomistic Metaphysics of Evolutionary Transformism

The point of departure is the abovementioned passage from Aquinas saying that "the form of the thing generated depends naturally on the generator in so far as it is educed from the potentiality of matter."[50] What Thomas has in mind here is, most likely, empirically verifiable secondary matter (*materia secunda*), a substance that has the potentiality to be shaped or transformed into a different substance. The potentiality in question is ultimately grounded in primary matter (*materia prima*), which Aquinas—following Aristotle—defines as the most basic metaphysical principle of potency (*prōtē hylē* [πρώτη ὕλη] = primary matter; *hypkeimenon physis* [ὑποκείμενοη φύσις] = underlying nature; or *prōtov hypkeimenon* [πρῶτον ὑποκείμενον] = primary substratum) that persists through all changes that a given substance can be exposed to.[51] As such it is matched by a complementary metaphysical principle of act—substantial form—which Aristotle

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50 *De Potentia*, q. 5, a. 1, corp.

51 See Aristotle, *Physics* 1.9.192a 25–33: "The matter comes to be and ceases to be in one sense, while in another it does not. As that which contains the privation, it ceases to be in its own nature, for what ceases to be—the privation—is contained within it. But as potentiality it does not cease to be in its own nature, but is necessarily outside the sphere of becoming and ceasing to be. . . . For my definition of matter is just this—the primary substratum [*prōtov hypokeimenon* (πρῶτον ὑποκείμενον)] of each thing, from which it comes to be without qualification, and which persists in the result." See also Aquinas, *De principiis naturae* 13, 14, 16: "[13]Only that matter which is understood without any form or privation, but which is subject to form and privation, is called prime matter, inasmuch as there is no other matter prior to it. It is also called 'hyle.' . . . [14] We know prime matter as that which is related to all forms and privations, as bronze is related to the form of a statue and to the privation of some shape. It is called primary without qualification. . . . [16] We should note also that prime matter is said to be numerically one in all things" (English trans. in *Selected Writings of St. Thomas Aquinas*, trans. by Robert P. Goodwin [New York: Bobbs-Merrill, 1965]).

describes as "the definition" or "the statement" of the essence of an entity (*ho logos tou ti ēn einai* [ὁ λόγος τοῦ τί ἦν εἶναι]), a principle causing a given substance (secondary matter—*materia secunda*) to be the particular kind of thing it is.[52] Hence, properly speaking, we should say that new substantial form is educed from the primary matter underlying empirically verifiable secondary matter.

Most importantly, as pure potentiality, primary matter can be actualized by any substantial form. At the same time, the type of form actualizing primary matter in case of a substantial change in which a given substance *A* is replaced by another substance *B* is not random. It depends both on the substantial form and on accidental forms actualizing *A*. These principles of actuality dispose *A* to enter specific accidental or substantial changes, which narrows the scope of potentialities of primary matter that may be actualized in a given change. To give an example, if you put a wooden log into a fire, it does not melt but burns and turns into a pile of ash, and not, let us say, into a butterfly. Although pure potentiality of primary matter underlying the log can be actualized by any substantial form, the fact that it is currently actualized by the substantial form of wood disposes it and sets up a limited scope of its potentialities that can be actualized within a limited range of substantial changes a wooden log may enter.

In other words, we may say after Aquinas that—together with accidental forms, which are responsible for secondary properties of a given entity (such as its size or color) and may change without it changing its identity—the substantial form of the entity in question disposes it, that is, becomes decisive about the array of new substantial forms that may be educed "from" the potentiality of primary matter that underlies it. The action of eduction (actualization of primary matter) is exercised by the efficient causality of one or many agents.

Commenting on this topic in the *Metaphysics*, Aristotle states what follows:

> Regarding material substance we must not forget that even if all things come from the same first cause or have the same things for

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[52] See Aristotle: *Physics* 2.3.194b26; *Metaphysics* 5.2.1013a27. On the defense of essentialism in biology, see: Michael Devitt, "Resurrecting Biological Essentialism," *Philosophy of Science* 75, no. 3 (2008): 344–82; Olivier Rieppel, "New Essentialism in Biology," *Philosophy of Science* 77, no. 5 (2010): 662–73; Travis Dumsday, "Is There Still Hope," *The Thomist* 76, no. 3 (2012): 371–95; and Christopher J. Austin, "Aristotelian Essentialism: Essence in the Age of Evolution," *Synthese* 194, no. 7 (2017): 2539–56.

> their first causes, and if the same matter serves as starting-point for their generation, yet there is a matter proper [i.e., properly disposed] to each, e.g., for phlegm the sweet or the fat, and for bile the bitter, or something else; though perhaps these come from the same original matter.[53]

Aquinas, in turn, comments on this passage thus:

> From the things which are said here then it is evident that there is one first matter for all generable and corruptible things, but different proper [i.e., properly disposed] matters for different things.[54]

And earlier, in the *Summa contra gentiles*, Aquinas has already postulated:

> Thus, form and matter must always be mutually proportioned and, as it were, naturally adapted, because the proper act is produced in its proper [i.e., properly disposed] matter. That is why matter and form must always agree with one another in respect to multiplicity and unity.[55]

Speaking of the importance of the proper disposition of primary matter for particular accidental and substantial changes of a given substance, Aquinas formulates an observation that might inspire a new development of the classical notion of hylomorphism, enabling it to provide a necessary metaphysical foundation for the contemporary version of the theory of evolution:

> From the fact that matter is known to have a certain substantial mode of existing, matter can be understood to receive accidents by which it is disposed to a higher perfection, so far as it is fittingly disposed to receive that higher perfection.[56]

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53 Aristotle, *Metaphysics* 8.4.1044a 15–20. All translations of the works of Aristotle are taken from *The Basic Works of Aristotle*, ed. Richard McKeon (New York: Modern Library, 2001).

54 Aquinas, *In* VIII *metaphys.*, lec. 4, no. 1730 (trans. in *Commentary on The Metaphysics of Aristotle*, trans. John Rowan [Chicago: Regnery Press, 1961]).

55 Aquinas *Summa contra gentiles* [*SCG*] II, ch. 81, no. 7 (trans. in *On the Truth of the Catholic Faith: Summa Contra Gentiles. 4 vols.*, trans. Anton C. Pegis, et al. [Garden City, New York: Image Books, 1955–1957])

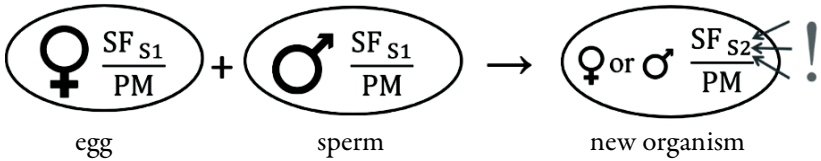
56 *Quaestio disputata de anima*, q. 9, corp. (trans. in *Quaestions on the Soul*, trans.

Based on this assertion, despite the fact that Aristotle thought species were eternal (everlasting) and Aquinas—with the rare exceptions of species originating from putrefaction and interbreeding—considered them as created without ancestors in the form of seminal seeds (potencies), dormant in primordial matter and actualized (with or without direct divine intervention?) under favorable conditions of the environment, we may describe natural kinds of animate creatures as evolving. They may be seen and classified as lineages of closely related organisms, whose underlying primary matter is gradually disposed to be informed by novel and more perfect substantial forms, educed from its potentiality. Certainly, metaphysical perfection—defined in terms of the complexity and scope of active and passive dispositions of a given entity—is not equivalent to the biological and evolutionary perfection defined in terms of reproductive success and dominant occupying of an ecological niche. However, this does not prevent us from conceiving natural kinds within the framework of the classical Aristotelian-Thomistic metaphysics as evolving.

An evolutionary transition might be thus defined, in this account, as a series of minor genetic and epigenetic changes that effect minor phenotypic variations (accidental changes), which, in turn, gradually change the disposition of primary matter underlying subsequent organisms of the lineage L_1 of the species S_1. This process, highly complex and extended in time, might lead to a precise instant at which the primary matter underlying the egg and the sperm coming from particular female and male organisms of sexually reproducing species S_1,[57] at their entering the substantial change in which they join and give an origin to a new organism, is not disposed to be actualized by the "old" substantial form of the species S_1, but by a "new" substantial form of the species S_2, which is educed from the potentiality of primary matter that underlies them. The new organism (or organisms, as the process described here is commonly considered to take place within a population) starts a new lineage L_2, which happens to be the lineage of the new species S_2. See Figure 2.

James H. Robb [Milwaukee, WI: Marquette University Press, 1984]). See also *In* II *de an.*, lec. 7, no. 315; *De potentia*, q. 5, a. 1, corp. and ad 5; *SCG* III, ch. 22, no. 7; Antonio Moreno, "Some Philosophical Considerations on Biological Evolution," *The Thomist* 37, no. 3 (1973): 417–54, at 440–41.

57 Similar metaphysical analysis may be developed with reference to organisms reproducing asexually.



SF = substantial form
PM = primary matter
$S_1 S_2$ = species 1 and 2

Figure 2. Hylomorphic metaphysics of an evolutionary transition.

Gametes—parental egg and sperm—are separate entities and may be treated as instrumental causes, acting under principal causation of the organisms that produced them. Normally, when they join, entering thus a substantial change which becomes an origin of the existence of a new organism, the primary matter that underlies them is disposed to be actualized by the original substantial form of the type S_1. In case of an evolutionary transition, however, accidental changes in the DNA and the epigenetic causal factors inherently affecting phenotypes of the consecutive organisms within the lineage L_1 lead to the situation in which primary matter, actualized by the given egg and sperm, produced by female and male organisms of species S_1, is disposed to be actualized in the substantial change these gametes enter by a new substantial form of the type S_2, which is educed from its potentiality. This originates the new evolutionary lineage L_2.

It takes many mutations and epigenetic changes (the outcomes of which are regulated by natural selection) to produce such an effect, and its actual occurrence may be extremely difficult (if not impossible) to capture. But this does not exclude the possibility of its occurring, especially in a situation where some members of a species migrate to a new environment and can be modified gradually in subsequent generations, to the point where they can no longer mate with the other descendants of their ancestors.[58]

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[58] This concept of the metaphysics of evolutionary transitions is inspired by the works of a number of Thomistic philosophers and theologians. Among them, we would like to mention in particular: (1) Antonio Moreno, "Some Philosophical Considerations"; (2) Fran O'Rourke, "Aristotle and the Metaphysics of Evolution," *The Review of Metaphysics* 58 (2004): 3–59; (3) William E. Carroll, "At

Redefinition of the Concept of Rationes Seminales

The constructive proposal of the Thomistic metaphysics of evolutionary transitions presented here reframes both Augustine's notion of *rationes seminales* and Aquinas's interpretation of its main objectives, within the context of the core principles of Aristotelian metaphysics in its encounter with contemporary science. We suggest seed-principles should not be defined as organisms virtually present in their dormant forms, hidden forces, or potencies (fixed and limited in number), that are inherent to the most primitive matter created with the origin of the universe. We might redefine them, instead, in terms of the two levels of potentiality inherent in the very fabric of the cosmos: (1) pure potentiality of primary matter (*materia prima*), which can be actualized by all possible types of substantial forms, proper for both inanimate and animate natural kinds; (2) potentiality of primary matter underlying each and every instantiation of secondary matter (*materia secunda*), which is specified (qualified) by the substantial form and accidental forms characteristic of a particular natural kind it belongs to.

The principles actualizing entities classified as instantiations of secondary matter dispose their underlying primary matter in particular way, enabling thus—on the way of substantial change—an eduction of particular types of new substantial forms (typical of other natural kinds) from its potentiality. This allows for introducing the idea of evolutionary changes and transitions within the framework of the Aristotelian-Thomistic metaphysics and philosophical theology.

The advantage of the proposed model is that, on the one hand, it does not constrain the idea of *rationes seminales* to their interpretation in terms of the potentiality of mere unfolding of what has always been actually present in some latent form in the fabric of the cosmos. In other words, it allows for the genuine novelty of evolutionary processes, leading to the origin of new natural kinds which were not present before at any level of actuality. On the other hand, the originating new types of natural kinds do not come into existence out of nothing (*ex nihilo*). Rather, they are "written" in the above-mentioned, clearly distinguished and specified two levels of potentiality inherent to the reality of the universe and the entities it contains.

What is crucial in this account is what the Aristotelian-Thomistic metaphysics understands under the term "potentiality." It does not perceive it

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the Mercy of Chance? Evolution and the Catholic Tradition," *Revue des questions scientifiques* 177 (2006): 179–204; and (4) Étienne Gilson, *From Aristotle to Darwin and Back Again: A Journey in Final Causality, Species, and Evolution* (Notre Dame, IN: University of Notre Dame Press, 1984).

as the potency for a limited number of (fixed) natural kinds to unfold from already existing secondary matter. Rather, it sees it, ultimately, as one of the most basic metaphysical principles underlying the very fabric of the universe, a potency that may be actualized by any substantial form. Obviously, primary matter, as such, is always actualized by a given substantial form, which limits the range of possible future actualizations it may go through. At the same time, the flexibility of the dynamic processes is such that the fact that primary matter is informed at time t_1 by the substantial form SF_1, which disposes it to be actualized in the next substantial change at t_2 by the substantial form SF_2, while preventing it from being actualized (in the same substantial change at t_2) by the substantial form of SF_{2*}, does not prevent it from being actualized by SF_{2*} after a number of substantial changes it may go through. They may dispose it such that, at one point, it may actually be "ready" to be informed by SF_{2*}. For the potentiality of the secondary matter, although relative and limited, as ultimately grounded in the pure potentiality of primary matter, changes on the way of substantial and accidental transformations that a given "portion" of secondary matter enters. See Figure 3.

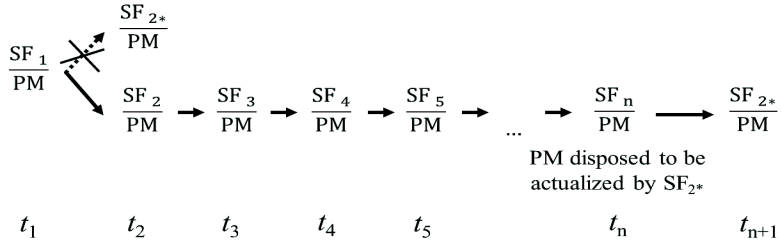

Fig. 3. Two levels of potentiality and the flexibility of the dynamic processes in nature.

Hence, the two levels of potentiality that we can define within the Aristotelian-Thomistic metaphysics seem to enable us to provide an accurate description of the dynamic and flexible character and nature of the reality—the one that is in line with contemporary science.

Conclusion

In conclusion, we would like to specify some important ways (four) in which the proposed model both mirrors and goes beyond the philosophical aspects of Aquinas's notion of creation and his reflection on the work of six days in Genesis.

(1) Since evolutionary processes are classified as productive of new types of natural kinds, and not as creating them *ex nihilo*, our understanding of the act of creation, following the one offered by Augustine and Aquinas, limits it to the origin of the least complex primordial (secondary) matter. Consequently, evolutionary processes, as such, belong to the work of adornment (*opus ornatus*) within Aquinas's distinction of the three stages in the Genesis account of the work of six days.

(2) As a Result, the work of six days is not completed, as its last stage is still ongoing and effects the origin of new types of natural kinds, both animate and inanimate—if we wish to extend the scope of our analysis beyond biological evolution and to reflect upon its chemical and physical counterparts.[59]

(3) The origin of new species occurs through "production" (*productio*) from pre-existing matter with ancestry, in a process of universal common descent, within a complex nexus of genetic and epigenetic variations, the outcomes of which are regulated by natural selection, "working" on populations that consist of concrete organisms, characterized by their natural teleological tendencies to survive and produce fertile offspring.

(4) With the exception of the origin of man, whose soul—created directly *ex nihilo* at the moment of his/her conception—actualizes primary matter properly disposed within the lineage of his/her parental hominids, evolutionary transformations do not require God's direct causal intervention. This, naturally, does not exclude or prevent such an intervention of the Creator in the natural processes (including evolutionary processes), at his will and command.[60]

It is worth noting that even if points (2), (3), and (4) might be considered as going beyond the way Aquinas understood and explained creation, their

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[59] Contrary to this assertion we find Aquinas saying that: "In its beginning the universe was perfect with regard to its species [*quantum ad species*]" (*De potentia*, q. 4, a. 2, ad 22); "Nothing entirely new was afterwards made by God, but all things subsequently made had in a sense been made before in the work of the six days" (*ST* I, q. 73, a. 1, ad 3). On the other hand, we also find him asserting that: "The universe in its beginning was perfect . . . as regards nature's causes from which afterwards other things could be propagated, but not as regards all their effects" (*De potentia*, q. 3, a. 10, ad 2); "When he [God] made things out of nothing he did not at once bring them from nothingness to their ultimate natural perfection, but conferred on them at first an imperfect being, and afterwards perfected them, so that the world was brought gradually from nothingness to its ultimate perfection" (*De potentia*, q. 4, a. 2, corp.).

[60] Contrary to assertions (3) and (4) is (above-mentioned) Aquinas's conviction that "the first members of the species were immediately created by God, such as the first man, the first lion, and so forth" (*In* II *sent*., d. 1, q. 1, a. 4, corp.).

introduction seems to be necessary, taking into account contemporary science, the current status of evolutionary biology in particular, and the most recent scientific and philosophical analysis of causation and causal relationships in nature. At the same time, they certainly do not contradict any of the core principles of the Aristotelian-Thomistic philosophy and theology. Quite the contrary, the possibility of harmonizing them with the main objectives of the classical thought proves the flexibility of the latter and its relevance within the context of contemporary science. N·V